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- (71) Applicant (*for all designated States except US*): **BOREALIS TECHNOLOGY OY** [FI/FI]; P.O. Box 330, FIN-06101 Porvoo (FI).
- (72) Inventors; and
- (75) Inventors/Applicants (*for US only*): **EDWIN**, Emil [NO/NO]; Markv. 24, N-7043 Trondheim (NO). **ARNESEN, Tore** [NO/NO]; Sigurd Høidalv 3A, N-7053 Ranheim (NO).
- (74) Agents: **FRANK B. DEHN & CO.** et al.; 179 Queen Victoria Street, London EC4V 4EL (GB).
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- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(54) Title: METHOD AND DEVICE FOR VIEWING A BURNER FLAME

(57) Abstract: A method of viewing the flame produced by a burner in a furnace is provided, comprising viewing the flame through an interference filter adapted to pass light of only a narrow wavelength range, in which the wavelength range corresponds to a wavelength which is stronger in the light emitted by the burner than in the ambient light of the furnace. The method is particularly applicable to viewing the flames produced by natural gas burners in petroleum crackers and the preferred wavelength range is that of sodium.

WO 03/085388 A1

- 1 -

METHOD AND DEVICE FOR VIEWING A BURNER FLAME

5 The present invention relates to a method and apparatus for viewing a flame in a furnace, such as for example a burner flame in the pyrolysis section of a petrochemical cracker reactor.

10 In a petroleum cracker, large hydrocarbon molecules such as ethane and propane from natural gas, or heavier liquids such as naphta and gas oil from petroleum are split into smaller molecules. This is often done to provide olefins such as ethylene that are useful in themselves, or may be used in polymerisation processes.

15 In the case of ethane and propane, the gas is heated to above about 800°C at which point bonds within the molecule break, producing a range of smaller molecules. The desired products are then separated out. The same principle applies when cracking heavier substances, but since the molecules are much larger, a far greater range of smaller molecules is provided. Although some processes provide a smaller yield of olefins, many other useful by-products are produced.

20 In a typical ethane cracker plant, the cracking takes place in a pyrolysis section. Here, ethane is pumped through a maze of 100-150mm diameter tubes located within a furnace where it is heated up to about 800°C and cracks. The ethane never comes into direct contact with the source of heat, if it were to do so it would ignite disastrously.

25 Typically, the pyrolysis section includes a plurality of burners which are positioned adjacent the tubes through which the ethane is pumped. The burners combust a fuel such as natural gas in order to heat the gas in the tubes to the required temperature.

30 To achieve maximum thermal efficiency of the cracker the flame from each of the burners should be maintained at the required size and orientation. This

- 2 -

can be done by adjusting the quantity of fuel supplied to the burner and/or by adjusting the ratio of fuel supplied to air and/or by adjusting the direction of the jets of fuel.

5 In order to monitor the size and orientation of the burner flames, an operator views the flames at regular intervals and then makes any adjustments which may be required. However, the heat in the pyrolysis section is such that the walls of the cracker are heated to a
10 temperature of about 1100°C. Consequently, radiant heat is given off from the walls to create a bright background against which it is very difficult to see the burner flames.

 In the past, this problem has been overcome by
15 adding either copper or sodium bicarbonate to the flames to provide a colour which is visible against the bright background of the walls of the cracker. To do this however, the pyrolysis chamber must be opened up and the copper or sodium bicarbonate thrown into the flames. It
20 will be appreciated that at the operating temperatures in question this is a complex procedure which results in significant inconvenience and energy losses.

 The present invention seeks to provide a method of viewing the flames of the burners in a furnace such as
25 the pyrolysis chamber of a cracker which can be carried out quickly and easily and without the need to lose heat from the furnace.

 The applicants have realised that if the light emitted by the burner flames or a part of that light
30 could be separated from the background radiant light in the furnace, the burner flames could then be viewed without the need for complex solutions such as throwing additives into the flames.

 From a first aspect, the present invention provides
35 a method of viewing the flame produced by a burner in a furnace, comprising viewing the flame through an interference filter adapted to pass light of only a

- 3 -

narrow wavelength range, wherein the wavelength range corresponds to a wavelength which is stronger in the light emitted by the burner flame than in the ambient light of the furnace.

5 Thus, the interference filter acts to block out the bulk of the ambient light of the furnace such that the burner flame is clearly visible.

 It will be appreciated that the wavelength range of the interference filter could be determined by carrying
10 out a spectroscopic analysis of the burner flame to find the wavelength of a peak in the spectrum thereof.

 In one preferred embodiment of the invention, the furnace is the pyrolysis section of a petroleum cracker. The method is particularly advantageous in such an
15 environment as the walls of the cracker are heated to a very high temperature such that they emit significant levels of white light which makes it difficult or even impossible to see the flame of a burner in the cracker under normal circumstances.

20 Typically, the fuel which is burnt in the petroleum cracker is natural gas and most typically, a mixture of hydrogen, methane and air. Tests have shown that this fuel can contain traces of sodium. The reason for this is not known but it is thought to be because methane and
25 natural gas often come from environments in which salt is present. In a preferred embodiment of the method of the invention therefore, the filter used is a sodium interference filter which filters out substantially all the light other than the sodium light emitted by the
30 sodium trace elements in the fuel.

 Preferably the sodium interference filter has a pass bandwidth of approximately 10nm so that light of wavelength 0.584 to 0.594 μ m may pass through the filter. More preferably the pass bandwidth is 2 to 5nm and,
35 still more preferably, the pass bandwidth is 1nm so that only light of wavelength 0.589 μ m passes through the filter.

The use of a sodium interference filter is particularly advantageous as there is effectively no light of the wavelength of sodium present as ambient light in the furnace such that the burner flame is very
5 clearly visible using this method.

The use of a sodium interference filter to view a burner flame in a furnace is considered to be novel and inventive in its own right and so, from a further aspect, the present invention provides a method of
10 viewing the flame produced by a burner in a furnace, comprising viewing the flame through an interference filter adapted to pass light of the wavelength of sodium only.

The sodium interference filter could take any form and the burner in the furnace could be viewed through a
15 door which is opened in use as in known systems. Preferably however, a window is provided in the wall of the furnace through which the burner can be viewed. This has the advantage that the furnace does not need to
20 be opened each time that the burners are viewed. Thus the temperature inside the furnace is not disturbed and thermal currents which can distort the action of the burner flame are not created by opening and closing the furnace at regular intervals.

25 Preferably, the window is made of quartz which is a material capable of withstanding the temperature gradient across the wall of the furnace while also providing the necessary transparency.

In one preferred embodiment, the interference
30 filter could be provided as a panel attached to the window of the furnace.

Still more preferably, the filter is a panel which can be placed over the window or removed by a user as required. Thus for example, the filter could be hinged
35 to the wall of the furnace to allow quick and easy adjustment thereof.

In an alternative embodiment, a pair of glasses or

- 5 -

goggles comprising an interference filter in each lens thereof is provided. This has the advantage of allowing a user to carry the glasses with him for example from one furnace to the next. The goggles have the
5 additional advantage that they could also be used with a traditional furnace in which no sealed window is provided but a door is merely opened when a user wishes to look inside the furnace.

In a still further preferred embodiment of the
10 invention, the interference filter could be provided in a camera arranged inside the furnace and adapted to photograph the burner at regular intervals. The information from the camera could then be relayed to an operator who could make any necessary adjustments to the
15 burner from a remote location. This would clearly be advantageous in a large scale refinery or similar scale production plant where considerable numbers of personnel would be required to monitor the operation of each furnace in situ.

20 Ideally the camera could be programmed to photograph the burner about once every 10 minutes.

It will be appreciated that the furnace would normally include a plurality of burners and, in the case of a petroleum cracker, ten or more burners could be
25 provided. Thus if necessary, the camera could be programmed to move along a row of burners and to take several pictures of respective burners or groups thereof.

From a further aspect, the present invention
30 provides an apparatus for viewing the flame produced by a burner in a furnace, comprising an interference filter adapted to pass light of only a narrow wavelength range, wherein the wavelength range corresponds to a wavelength which is stronger in the light emitted by the burner
35 than in the ambient light of the furnace.

Preferably, the interference filter is a sodium interference filter.

- 6 -

The provision of a sodium interference filter is considered to be novel and inventive in its own right and so from a further aspect, the present invention provides an apparatus for viewing the flame produced by a burner in a furnace, comprising an interference filter adapted to pass light of the wavelength of sodium only.

In one preferred embodiment, the apparatus further comprises a window provided in the wall of the furnace through which the burner can be viewed.

Preferably, the window is made of quartz.

In one preferred embodiment, the interference filter could be provided as a panel attached to the sealed window of the furnace.

Still more preferably, the filter is a panel which can be placed over the window or removed by a user as required. Thus for example, the filter could be hinged to the wall of the furnace to allow quick and easy adjustment thereof.

The provision of a panel over the window is considered to be novel and inventive in its own right and so, from a further aspect, the present invention provides a furnace comprising a burner housed within the walls thereof and a window provided in a wall of the furnace, wherein an interference filter adapted to pass light of only a narrow wavelength range is provided in or on the window.

In an alternative embodiment, the apparatus comprises a pair of glasses or goggles comprising an interference filter in each lens thereof.

The provision of such goggles is also considered to be novel and inventive in its own right and so, from a further aspect, the present invention provides glasses comprising an interference filter provided in each lens thereof, wherein the interference filter is adapted to pass light of only a narrow wavelength range.

In another alternative embodiment of the invention, the apparatus comprises a camera in which the

- 7 -

interference filter is provided, wherein the camera is arranged inside the furnace and adapted to photograph the burner at regular intervals. The information from the camera could then be relayed to an operator who
5 could make any necessary adjustments to the burner from a remote location.

Ideally the camera could be programmed to photograph the burner about once every 10 minutes.

It will be appreciated that the furnace would
10 normally include a plurality of burners and, in the case of a petroleum cracker, ten or more burners could be provided. Thus if necessary, the camera could be programmed to move along a row of burners and to take pictures of respective burners or groups thereof.

15 Preferred embodiments of the invention will now be described, by way of example only, and with reference to the accompanying drawings in which:

Figure 1 schematically shows a pyrolysis section of a petroleum cracker; and

20 Figure 2 shows a pair of goggles according to one embodiment of the invention.

As shown in Figure 1, a petroleum cracker includes a pyrolysis section 1 in which petroleum is heated in order to carry out the cracking process. The pyrolysis
25 section includes a number of pipes or tubes 3 through which the petroleum flows in use. Burners 5 are provided in the base 7 of the pyrolysis section and further burners 9 are also provided in the rear wall 11. The burners 5, 9 burn a mixture of hydrogen, air and
30 methane supplied to them by a pipe network (not shown).

The burners each produce a naked flame 13, the size and orientation of which must be controlled in order to ensure even heating of the petroleum pipes 3. In order to monitor the size and orientation of the flames 13, a
35 window 15 made of quartz is provided in a wall of the pyrolysis section. The window is sealed so that the temperature and stability of the burner flames inside

- 8 -

the pyrolysis section are not affected by air currents from the window.

As shown in Figure 2, goggles 17 are provided to be worn by a user when viewing the flames 13. A sodium interference filter 19 is provided in each lens of the goggles as shown. The sodium interference filters have a pass band of approximately 1nm so that only light of wavelength $0.589\mu\text{m}$ passes through the filters. Thus, when a user wearing the goggles views the flames 13 of the burners 5, 9 through the window 15, only light from sodium trace elements in the burner flames is visible and the ambient light from the walls of the pyrolysis section which glow white hot is filtered out. Thus, the user can see the flames clearly and so can determine whether any adjustment to their size and/or orientation is required.

Any adjustments to the burner flames which are required are carried out by adjusting the quantity of fuel supplied to individual burners and/or the ratio of air to fuel supplied to the burners and/or by adjusting the direction of the jet of fuel emitted by the individual burners.

It will be appreciated that the embodiment of the invention described above is only a preferred embodiment thereof. Thus many variations could be made thereto without departing from the scope of the invention as claimed. For example, the interference filters provided could have a pass band of different wavelength, corresponding for example to the wavelength of another trace element in the burner flames. Further, the interference filter could be provided in or on the window to the furnace itself or in a camera arranged inside the furnace rather than in the goggles described above.

It will therefore be appreciated that the above description is given by way of example only and is not intended to be limiting.

Claims

1. A method of viewing the flame produced by a burner in a furnace, comprising viewing the flame through an interference filter adapted to pass light of only a narrow wavelength range, wherein the wavelength range corresponds to a wavelength which is stronger in the light emitted by the burner than in the ambient light of the furnace.
2. A method as claimed in claim 1, wherein the filter is a sodium interference filter.
3. A method of viewing the flame produced by a burner in a furnace, comprising viewing the flame through an interference filter adapted to pass light of the wavelength of sodium only.
4. A method as claimed in claim 1, 2 or 3, wherein the furnace is the pyrolysis section of a petroleum cracker.
5. A method as claimed in any preceding claim, wherein the fuel burnt by the burner is natural gas.
6. A method as claimed in any preceding claim, wherein the fuel burnt by the burner is a mixture of hydrogen, methane and air.
7. A method as claimed in any preceding claim, wherein a window is provided in the wall of the furnace through which the burner can be viewed.
8. A method as claimed in claim 6, wherein the window is made of quartz.
9. A method as claimed in claim 7 or 8, wherein the interference filter is provided as a panel attached to

- 10 -

the window of the furnace.

10. A method as claimed in claim 9, wherein the panel
is hinged to the furnace so it can be placed over the
5 window or removed by a user as required.

11. A method as claimed in any preceding claim, wherein
a pair of glasses or goggles having an interference
filter in each lens thereof is provided.

10

12. A method as claimed in any preceding claim, wherein
the interference filter is provided in a camera arranged
inside the furnace and adapted to photograph the burner
at regular intervals.

15

13. A method as claimed in claim 12, wherein the
information from the camera is relayed to an operator
who makes any necessary adjustments to the burner from a
remote location.

20

14. A method as claimed in claim 12 or 13, wherein the
camera is programmed to photograph the burner about once
every 10 minutes.

25

15. A method as claimed in any of claims 12 to 14,
wherein the camera is programmed to move along a row of
burners and to photograph groups of one or more burners
in turn.

30

16. An apparatus for viewing the flame produced by a
burner in a furnace, comprising an interference filter
adapted to pass light of only a narrow wavelength range,
wherein the wavelength range corresponds to a wavelength
which is stronger in the light emitted by the burner
35 flame than in the ambient light of the furnace.

17. An apparatus as claimed in claim 16, wherein the

- 11 -

interference filter is a sodium interference filter.

18. An apparatus for viewing the flame produced by a burner in a furnace, comprising an interference filter
5 adapted to pass light of the wavelength of sodium only.

19. An apparatus as claimed in claim 16, 17 or 18, wherein a window is provided in the wall of the furnace through which the burner can be viewed.
10

20. An apparatus as claimed in claim 19, wherein the window is made of quartz.

21. An apparatus as claimed in claim 19 or 20, wherein
15 the interference filter is provided as a panel attached to the window of the furnace.

22. An apparatus as claimed in claim 20 or 21, wherein the filter is a panel which can be placed over the
20 window or removed by a user as required.

23. An apparatus as claimed in any of claims 16 to 22, wherein the apparatus comprises a pair of glasses or goggles comprising an interference filter in each lens
25 thereof.

24. An apparatus as claimed in any of claims 16 to 23, wherein the apparatus comprises a camera in which an interference filter is provided, wherein the camera is
30 arranged inside the furnace and adapted to photograph the burner at regular intervals.

25. An apparatus as claimed in claim 24, comprising means for relaying the information from the camera to an operator and means for making any necessary adjustments
35 to the burner from a remote location.

- 12 -

26. An apparatus as claimed in claim 24 or 25, wherein the camera is programmed to photograph the burner about once every 10 minutes.
- 5 27. An apparatus as claimed in any of claims 24 to 26, wherein the camera is programmed to move along a row of burners and to photograph groups of one or more burners in turn.
- 10 28. A furnace comprising a burner housed within the walls thereof and a window provided in a wall of the furnace, wherein an interference filter adapted to pass light of only a narrow wavelength range is provided in or on the window.
- 15 29. Glasses comprising an interference filter provided in each lens thereof, wherein the interference filter is adapted to pass light of only a narrow wavelength range.

1/2

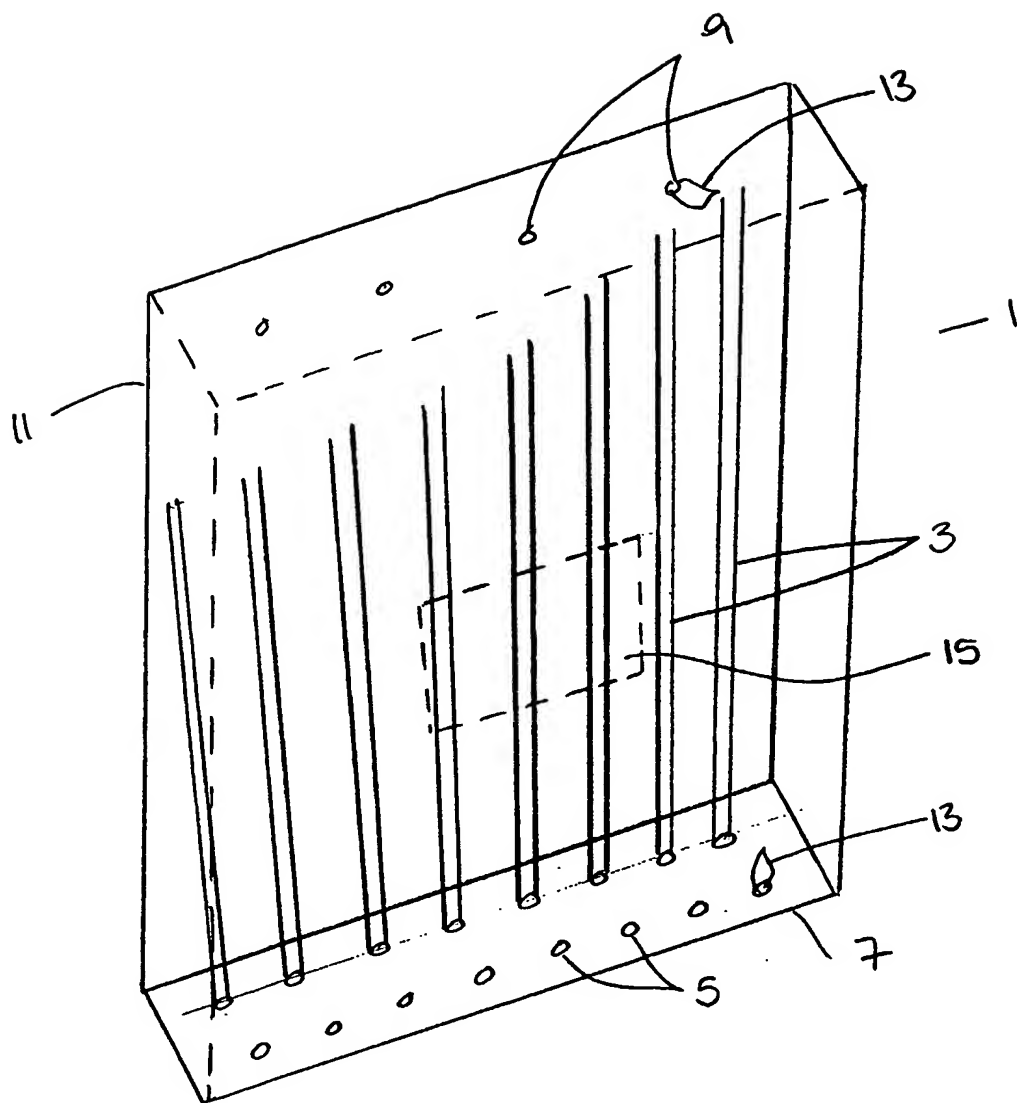


FIG. 1

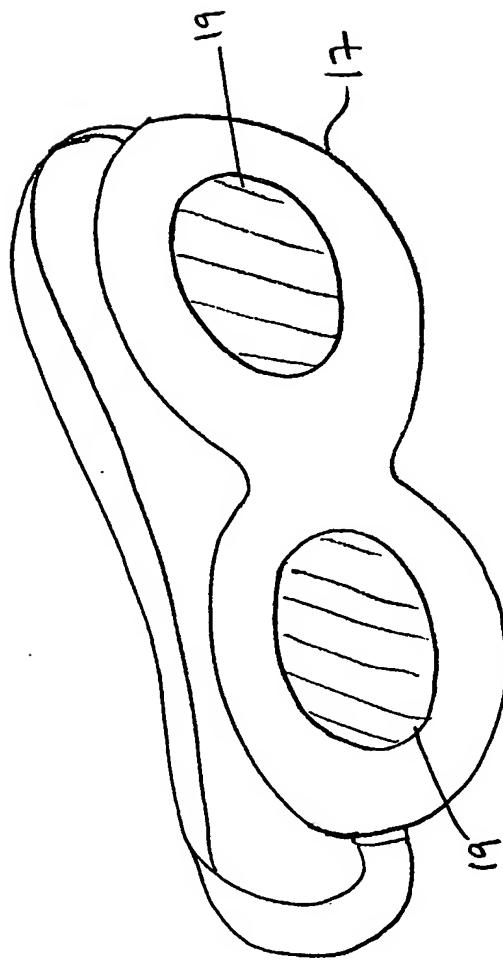


FIG. 2

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/EP 02/04044

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G01N21/72 A61F9/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G01N A61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 820 046 A (SOHMA KENICHI ET AL) 11 April 1989 (1989-04-11) column 1, line 30 - line 55 column 2, line 18 - line 37	1-28
X	US 4 466 943 A (MURASE ISAO ET AL) 21 August 1984 (1984-08-21) column 3, line 41 - column 4, line 12; figure 1	1-28
X	GB 1 128 625 A (ATOMIC ENERGY AUTHORITY UK) 25 September 1968 (1968-09-25) column 1, line 15 - line 35	1-28
X	WO 99 50649 A (RICHARDSON GRANT STUART ;ROBINS GEORGE (GB); SECR DEFENCE (GB); JO) 7 October 1999 (1999-10-07) page 6, line 9 - line 15	1-28
-/--		

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents:

A document defining the general state of the art which is not considered to be of particular relevance

E earlier document but published on or after the international filing date

L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

O document referring to an oral disclosure, use, exhibition or other means

P document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

G document member of the same patent family

Date of the actual completion of the international search

3 February 2003

Date of mailing of the international search report

11/02/2003

Name and mailing address of the ISA

European Patent Office, P.B. 5618 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax (+31-70) 340-3016

Authorized officer

Scheu, M

INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 02/04044

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 1 605 192 A (COMMISSARIAT ENERGIE ATOMIQUE) 7 April 1983 (1983-04-07) claims 4,5; figures 1,2 -----	29

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-28

method and apparatus for viewing the flame produced by a burner in a furnace

2. Claim : 29

glasses

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP 02/04044

Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this International application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP 02/04044

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